Study on the daily prediction of non-contracted balancing energy bids

December 22, 2021
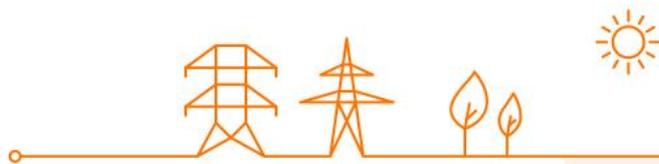
Content

1. Introduction

In line with Article 228 of the Belgian Federal Grid Code, Elia determines the dimensioning rules for Frequency Restoration Reserves or 'FRR' (also referred to as aFRR and mFRR). The last years, Elia focused on the implementation of dynamic dimensioning methodologies, i.e. calculating the reserve capacity needs for the next day based on the expected system risks.

With its study on the daily prediction of the non-contracted balancing energy bids, Elia is widening the scope to the calculation of the volumes of balancing means to cover the reserve capacity needs. Up to now, these were covered by means of a 'static' calculation of the available non-contracted balancing energy bids, reserve sharing and balancing capacity. While the methodology currently in place meets all legal requirements, Elia investigates with this study the possibility to predict the available non-contracted balancing means for the next day. This could facilitate the development of a dynamic calculation of the balancing capacity of the next day, based on expected reserve capacity needs, and availability of non-contracted balancing means. The study contains:

- the detailed description of the developed prediction methods ;
- the results of the final comparative analysis based on the selected performance criteria ;
- the conclusions and an implementation roadmap.

This consultation aimed to receive any comments from market participants and stakeholders regarding the consulted document and the consultation period was set from Friday October 1 to Monday November 1, 2021. In total, Elia received two non-confidential answers from FEBEG and FEBELIEC, as well as one confidential answer.

Following this consultation, the study report will be finalized and published by Elia on December 23, 2021. All relevant information to this consultation can be found on Elia's consultation webpage (**link**). The consultation did not lead to fundamental changes to the methodology or the results, but did result in additional clarifications in the final report.

- a clarification on the impact of modifications of non-contracted balancing energy bids close to real-time (cf. footnote 7 in the final report) ;
- a clarification on the forecast tool used to generate the day-ahead price forecast data used for training the machine learning algorithms (cf. footnote 8 in the final report).

2. Answers to the feedback of FEBEG

- FEBEG thanks ELIA for having the opportunity to react to ELIA's public consultation on the daily prediction of non-contracted balancing energy bids[1]. The inputs and suggestions of FEBEG are not confidential. FEBEG welcomes the effort to strive for a better market functioning and appreciates this well-documented and balanced study that also identifies the weak points of the proposals.

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[1]https://www.elia.be/en/public-consultation/20211001_public-consultation-on-the-daily-prediction-of-noncontracted-balancing-energy-bids

- Given the importance of procuring dynamically the reserves, FEBEG believes that Elia should be very careful when analyzing the results of this study and that representative data sets should be used before confirming any implementation plan. As a result, it seems a bit too optimistic and premature to already conclude at this point that non-contracted balancing energy can be predicted with sufficient accuracy. The conclusions and implementation plan of this study should be thoroughly analyzed because of the impacts it could have on the market liquidity and the overall adequacy needs[2]. We should avoid that units leave permanently the market as it would not only affect market liquidity but also long-term adequacy. Recent decisions on the dimensioning of FRR have shown that market liquidity lined up on the decrease of procurement.

Elia takes note of the remark and the position of FEBEG. In line with this, Elia explained in the executive summary that it proposes a follow-up study "*taking into account new system evolutions in the calculations of the potential being the explicit bidding of mFRR, the 12.5 minute full activation time for mFRR and the connection to the European balancing platforms for mFRR and aFRR. These modifications are expected to have an effect on the results, although it is currently very uncertain to which extend*". Elia also recognizes the potential impact on the market and proposes to conduct a specific follow-up study in 2022 on the procurement aspects of a dynamic allocation. "*This study will focus on the possibilities and impact of partially / intermittently reduce balancing capacity procurement on mFRR.*"

On the relation with adequacy, Elia confirms that it, in contrast to this study, still takes into account the risk of mFRR balancing capacity providing units leaving the market in the assessment of the available non-contracted balancing energy bids in its 'Methodology to determine the balancing capacity in the Elia LFC block', also referred to as the 'LFC Means'. However, Elia wants to stress that this is not a justification to maintain contracting mFRR balancing capacity on the long-term. Elia wants to remind that on longer term, capacity shortages, in the energy or the balancing market, relates to adequacy discussions. Ensuring adequate revenue streams for power plants is not the objective of Elia's reserves procurement. Elia however agrees that a healthy market requires sufficient foresight and transparency. It is exactly for this reason that reserve capacity requirements are accounted in the adequacy simulations, compliant with the European guidelines (methodology for the European Resource Adequacy Assessment).

- TSO sharing is an important element in the analysis, impacting the possibility to procure more or less volumes. We believe this assessment must be done in very close cooperation with surrounding TSOs. Any events such as an incorrect wind forecast does not stop at the border of Belgium and we believe that this kind of events are often correlated within Europe. FEBEG believes that historical available TSO sharings should focus specifically on events where there was actually mFFR import needs in Belgium. Analyzing available TSO sharings when there is no need in Belgium is a lot less relevant. Further, it will not be prudent to consider the availability of the reserve sharing with other TSOs as 'firm' in the determination of the balancing capacity to be procured. These reserves

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[2] FEBEG also refers to the comments on ELIA's Public consultation on a modification of the methodology to determine the balancing capacity in the Elia LFC block (dd 22/10/2021)

are never 'guaranteed' as the availability of cross-border capacity is not ensured because it is subject to the operational availability of interconnection capacity at borders as well as network operating constraints such as congestions, while we do experience events where Belgium is cornered in the results of flow-based domain.

As explained during the last consultation on the LFC Means, Elia recognizes that he occurrence of such large-scale cross-border events is indeed a concern and is being discussed with TSOs on a regional level. Regardless of additional actions that may be taken in the future, if such events would impact the availability of transmission capacity and service availability of the reserve sharing on Elia's 4 borders simultaneously, this would be taken into account in the calculations and result in a reduction of the contribution of reserve sharing.

Elia explained during the previous consultation of the LFC means, as well as in the explanatory note of the LFC Means, how it determines the contribution of its reserve sharing agreements with its four neighboring TSOs. It is based on a probabilistic analysis on the availability of transmission capacity and the service availability (taking into account the activation of the reserve capacity by the reserve providing TSOs) which follows the legal requirements specified in Article 157 of the System Operation Guidelines. Taking into account the above-mentioned constraints, Elia observed during the last calculation of the balancing capacity requirements to dispose of this capacity during 99.0% of the time. This availability level was expected to further increase with the interconnection with Germany.

Elia disagrees that when conducting this probabilistic analysis should be based on events in which the reserve sharing is effectively activated in Belgium as it does not expect that the LFC block imbalances are very strongly correlated with those of large neighboring control zones of France, Germany and United Kingdom.

- It is important to draw conclusions by analyzing data sets that are representative. In this context, the upcoming market design changes - such as explicit bidding, complex bid characteristics, reduced full activation time, etc. resulting from the PICASSO and MARI projects - are game changers impacting liquidity offered.. Inputs are even more relevant than models according to us. If you rely on data that are not reflecting future market conditions and market design, the outputs/ results of the models will be unreliable. Therefore, it would be prudent to await the return on experience of 1-2 years of go-live of PICASSO and MARI on these evolutions before starting to investigate different methodologies and models.

As explained in an answer to a previous question, Elia recognizes this issue and therefore plans a follow-up study to incorporate these evolutions. It also explicitly mentions in the executive summary of the study that: "t*hese modifications are expected to have an effect on the results, although it is currently very uncertain to which extend. As the last of these modifications will only be implemented in the final quarter of 2022, and more than a year of data is needed to conduct meaningful analyses, this update can only be conducted the soonest in 2023 or 2024.*"

- It is important to focus on studies with high enough reliability rate/ confidence interval. In particular, the error where models would forecast large amounts of offered non-contracted bids while lower amounts would be offered in reality can jeopardize grid security.

Elia explains it envisions a high reliability level of 99.0%. Nevertheless, Elia agrees that this is not the same as 'firm' or 'guaranteed'. Elia reminds that events where reserve capacity needs are not sufficiently covered by means of the available reserve means with be covered by Elia's escalation procedure, specified in Elia's LFC block operational agreement (submitted for approval to CREG on September 30, 2021).

- If Elia forecasts low amounts of non-contracted bids. It should be avoided that some players would be gaming on price capacity and/ or energy bids in an overly opportunistic way.

Elia takes note of this point and will incorporate this in its follow-up study on the procurement aspects of a daily dynamic calculation of the required balancing capacity requirements taking into account the predicted non-contracted balancing energy bids.

- FEBEG understands that pump-hydro units are key variables in the predictions, but considering a day versus night model seems too simplistic. We are skeptical that Elia could interpret the optimization of market parties operating those units. For instance, how will Elia monitor the energy limits and how will the Scheduling Agent optimize the assets in the coming hours?

Elia recognizes the simplicity and explains this in the report (Section 2.1): *"Developing a specific model for storage is complex and out of scope of this study, mainly since such model would become irrelevant after the implementation of explicit bidding in 2022. For this reason, a sensitivity analysis will be conducted on this target variable with a case where no energy constraints are accounted (assuming there is always some remaining energy for pumping or generation after day-ahead, and a case where no remaining energy is assumed."* This is also one of the reasons to conduct the proposed update of the study, i.e. after the implementation of explicit bidding for mFRR.

- Further, how can Elia forecast – in a very volatile and intermittent context - what the Scheduling Agent will be doing with these units the day after (Elia assessment is done in D-1 before 7 am). How does Elia treat the outage rates of the different units participating to non-contracted bids? How does Elia include congestion risks, meaning risks that a unit might be prevented to deliver reserve?

The methodology predicts the available flexibility based on historic observations of the available non-contracted balancing energy bids up to real-time. This therefore includes the withdrawal of bids and volumes between the day-ahead and the real-time. Nevertheless, unexpected power plant outages and congestions events may happen too infrequently to be captured by the algorithms when using a 99.0% reliability level. Elia reminds again that Elia has proposed the implementation of exceptional balancing measures (i.e. the escalation procedure) in cases the reserve needs would exceed the availability of the required balancing means.

- The current mFRR implicit bidding very likely overestimates the volumes that will be offered in explicit bidding (cfr. Complexity to represent BSP portfolio's with bid characteristics and bid firmness)

Elia refers to its previous answers explaining it will need to re-confirm the results after the implementation of the explicit bidding in a follow-up study.

- The combination of three methods (one sophisticated method with two less sophisticated) is not sufficiently justified in this study. The choice of the model based on a qualitative selection seems very simplistic and random as an approach. Elia should instead take the necessary time to analyze and focus on one of the models providing the high performance and reliability regardless of the level of complexity. It should be noted that the model that will be implemented to predict the non-contracted means must guarantee the highest possible accuracy to not jeopardize the security of the grid.

Elia followed best practices for the implementation of machine learning methods. It is not common practice to investigate every algorithm type, as this would be time consuming and inefficient approach. Therefore, as elaborated in the study, a first selection of algorithms expected to show the largest performance has been made based on an analysis by the machine learning experts of N-SIDE, after which there performance is quantitatively assessed and compared. If FEBEG can justify the need to test a particular method, Elia will consider this in the foreseen follow-up study when disposing of the latest data, capturing the foreseen market evolution. Elia also wants to mention that further calibration

of the existing algorithms in a later stage (during the proposed follow-up study or during implementation) might further improve the results.

- FEBEG can also confirm the observations that there is no potential for predicting the available non-contracted aFRR balancing means due to the limited availability of significant volumes as well as the limited data set of one year, and that no further analyses seemed useful at this point. As mentioned by Elia in this study, the large part of non-contracted aFRR means are provided with remaining capacity on CCGT, which mean that without balancing capacity procurement, the non-contracted balancing energy bids would neither be available. On the other hand, FEBEG can understand the current approach to not procure downward mFRR balancing capacity as long as observed non-contracted balancing means continue to cover the downward mFRR reserve capacity needs.

Elia takes note of these remarks.

- In this context, FEBEG would also like to remind its comment put forward in the consultation of the LFC means. FEBEG believes that there is a potential mismatch or inconsistency between on one hand the discussion in the context of offshore integration (in which BRPs are increasingly being asked to balance their portfolio and have the means to do so) and on the other hand the use of non-contractual flexibility to cover Elia's reserve requirements. The same issue exists in the MARI/PICASSO design in which BRP/BSP cannot change their explicit bids 20-25minutes before real time (which could be interpreted as the TSO having priority on this flexibility). If the same non-contracted means are to cover the BRP's needs and the TSO's needs, it must be avoided unambiguously that this leads to a double use, where in the end the BRP will be penalized.

Elia clarifies that the new design for mFRR / aFRR products allows market parties to :

- Submit and modify their bids up to 25 minutes (gate closure) before the start of the delivery period ;
- Decrease the volume of their bids after gate closure and up to real-time (for mFRR, without guarantee that the bid will not be selected by the platform) or 5 minutes before the start of the delivery period (for aFRR) if it can be demonstrated that these volumes are effectively used in the portfolio of the market party.

Elia foresees monitor the availability at gate closure and real-time. If the machine algorithms to predict non-contracted balancing energy bids are trained based on this real-time availability, this should give a correct representation of the available non-contracted balancing energy bids for Elia. This clarification is integrated in the final report (Footnote 7 - Section 2.1).

- FEBEG is of the opinion that it is too early to propose an implementation planning at this stage given the lack of reliable and representative data necessary to carry out a conclusive study. Therefore FEBEG considers that a second round of study is necessary – using reliable data sets post go-live of MARI & PICASSO– to elaborate a final implementation plan. Relying on current data can only give provisional directions but cannot conduct to definitive conclusions

Elia refers to previous answers given and thinks the opinion aligns well with the roadmap proposed in the study.

3. Answers to the feedback of FEBELIEC

- Febeliec would like to thank Elia for this consultation on the study on the daily prediction of non-contracted balancing energy bids. Febeliec finds the topic of contracted balancing capacity reserves very important, as the costs for this capacity reservation are paid for by consumers[3]. As such, any analysis looking into the possibility to reduce (or even abolish) balancing capacity reservation is interesting, insofar of course system security remains guaranteed. This study, which looks into the predictability of available non-contracted balancing energy bids for the next day in order to facilitate a dynamic calculation of the balancing means is in this framework a very relevant component. While Febeliec and its members are no experts in machine learning methodologies, and as such cannot give any additional advice on this specific topic and its components in the analysis, some conclusions of the report are interesting and lead to some general comments. Febeliec for example supports the conclusion that no downward mFRR balancing capacity needs to be procured, as is currently already the case and which the study substantiates further.

Elia takes note of Febeliec's support for investigating the predictability of non-contracted balancing energy bids.

- Concerning the upward mFRR balancing capacity, Febeliec still wonders whether the results could not also be interpreted that at least for certain periods/days no such capacity would need to be contracted, as the data shows that currently already for at least 14% of the time volumes of over 1GW can be found. While Febeliec understands that this might require further analysis, Febeliec insists that such analysis is conducted and the situation monitored as this share could become larger in the future and in any case savings on the related capacity reservation costs could have a non-negligible impact on consumer invoices.

Elia confirms this interpretation and refers to the implementation roadmap in the report in which it proposes to investigate the market implications of a 'partial' / 'intermittent' procurement in 2022.

- For aFRR, Febeliec understands that based on the (limited) dataset, no conclusion could yet be drawn, but insists that this exercise is conducted again once a sufficiently large dataset is available, as also in aFRR potentially very large future cost efficiencies could be realized. In any case, the study at hand provides the methodological foundation for such analysis and as such future analyses should become less time-consuming as they can build further on the already gained experience.

Elia takes not of this remark and refers to the implementation roadmap in the report in which it proposes to conduct this update in one of the proposed follow-up studies.

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[3] Febeliec also wants to reiterate its position that it considers that (at least part of) these costs should be directly assigned to the BRPs, in order to give them a stronger investment signal in new flexible capacity (or contracting it, which gives an investment signal to other actors) and allow BRPs with better balanced portfolios to benefit from their better performance compared to BRPs who perform less well, in order to give them a positive competitive edge and also alleviate the costs for their consumers, which are now equivalently invoiced for balancing capacity reservation, even if their BRP is not necessarily equally responsible for the need for such capacity reservation.

- Febeliec learned from the study that, at least in theory, replacing contracted with non-contracted capacity should not have a negative effect on the operation availability of non-contracted capacity delivered, which is already a significant conclusion on its own.

Elia confirms this conclusion, which follows the observations on the current bidding behavior of generating, storage and demand-side management units.

- In general, Febeliec would also like to point out that it is important to clean and filter datasets, in order to avoid that specific events, related to specific periods, conditions or balancing changes not (or no longer) relevant for the analysis continue to have an impact on the outcome. The same applies clearly also for future changes, not in the least the introduction of the PICASSO and MARI platforms in the Belgian bidding zone.

Elia takes note of the remark. Although it recognizes the possibility to filter data for the machine learning data (as for instance proposed as a possible solution if the day-ahead balancing obligation would be rolled back), this solutions should be approached with utmost caution and only be considered as a 'last resort'. The main advantage of using complex machine learning algorithms proposed in this study is to capture relations, which cannot be easily captured in a 'manual' way and we should be careful to not deteriorate the forecast accuracy by 'manual' interventions in the historic data. Furthermore, it is important to have sufficient large dataset and one should be careful to exclude too much data.

Elia also wants to explain that it is not straightforward to integrate the impact of future evolutions in machine learning approaches which are based on learning from historical observations. Capturing future evolutions would require simulation / extrapolation approaches, and in the case of the EU balancing platforms, this would require a view on the liquidity which is expected to be observed on the platforms, which is currently not the case.

- However, Febeliec regrets that Elia postpones any meaningful conclusions or next steps towards 2023-2024 (and thus implementation even further in the future) because of in particular the introduction of the European platforms (as well as some other changes). While Febeliec understands that these platforms will have an impact, Febeliec wants to point out that nonetheless Elia will continue with other design changes, such as the phase-out of mFRR Flex, and does not consider the impact of the switch to the European platforms to have a significant negative impact on the liquidity of the Belgian system and as such there should also be no negative impact on the scope of this study. Or alternatively, if such negative impact were to be expected, some choices made by Elia which could impact liquidity, a.o. the phase-out of mFRR Flex, could be questionable[4]. Moreover, Febeliec wants to point out that in the recent years, the design of the balancing products has encountered continuous bigger and smaller changes and as such delaying any meaningful conclusions on the prediction of non-contracted balancing means and the impact on contracting of capacity reservation until a few years in the future seems not only long but also wishful thinking as *ceteris paribus* will clearly not apply in the (near)

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[4] Febeliec refers here also to answers on other consultations on this topic, in particular the recent consultation on the proposal of Elia to phase-out mFRR Flex.

future for balancing products, if ever. Febeliec asks Elia thus to be more ambitious on this point as well as to be more coherent and consistent in its choices in the balancing timeframe.

Elia does not agree with the justifications given by FEBELIEC to pursue an earlier implementation. While the connection to the platforms MARI and PICASSO are indeed expected to increase liquidity, the implementation of explicit bidding and 12.5 minute FAT is rather expected to reduce the availability. In addition, the expected impact of all evolutions together, is expected to be too large to be handled by the algorithms. Indeed, the machine learning methodologies, trained on historic data will be trained on observations which are likely not very representative anymore which may result in inaccurate forecasts.

The analogy with the phase out with mFRR flex is not clear as this study concerns non-contracted balancing energy bids while for mFRR flex, it concerns the availability of balancing capacity bids which are expected to be sufficient to remain sufficient to cover the balancing capacity requirements determined with Elia's 'LFC Means'. Elia refers to the answers given in the consultation on the phase out of the mFRR Flex product, in parallel with this consultation.

Elia also wants to stress that the nature of the expected evolutions (explicit bidding, reduction of the full activation time and the implementation of the EU balancing platforms) may cause a rather large effect on the results obtained in this study (due to the disruptive effect on the historic observations). Future product design modifications related to the balancing capacity are likely to be more incremental with less effect on the results, or at least a better view on the expected effect on the results, which allows easier extrapolations.

- In general, Febeliec would also like to better understand for Elia intends to forecast the day-ahead market price. Elia mentions this will be done base on a forecast tool available at N-SIDE, but to Febeliec's knowledge such tool and its outcome have not been presented or discussed with the market parties. As the forecast of the day-ahead market price could have an important impact on the outcome of this study and thus on the costs for consumers (as they pay for the balancing capacity reservation), Febeliec would like to have a better view on this tool and the way its inputs are used, as it is to be avoided that the TSO through its sourcing (based on tools and price forecasts) would start to impact market price formation also in other markets than the balancing market and as such would either create self-fulfilling prophecies or undermine its own results.

Time series day-ahead price forecasts are used as an input feature of the algorithms studied to capture the relation between the schedules of price-sensitive assets and the remaining flexibility, which can be offered as non-contracted balancing energy bids. Historic price forecast time series are used from an existing price forecast tool as the development of such price forecasts is outside the scope of this study. On request of Febeliec, further explanations on the price forecast tool is added in the report (Footnote 8 - Section 2.2.4) :

"*The day-ahead price forecast data is provided in the framework of this study based on the results of N-SIDE's commercialized price forecast method which uses a random forest machine learning algorithm. The following features are known at the moment of prediction (in this case before the balancing capacity gate closure) and are used as input of the forecast:*

- *Time (day, week, month and trigonometric transformations)*
- *Day-ahead price in the previous reference day/week*
- *Temperature and wind speed forecasts*
- *Load, wind and solar forecasts (and transformation to the residual load forecast)*

- *Trends (transformations on forecast D-1 - actual D) for, load wind, solar and residual load forecasts*
- *Expected available capacity of nuclear generation and total generation*

The performance shows a relative mean absolute error smaller than 3% of the observed value which is comparable to other providers."

Project spokesperson

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